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THESIS

THE IMPACT OF COGNITIVE FEEDBACK ON THE PERFORMANCE OF INTELLIGENCE ANALYSTS

by

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Human judgement and the process of decision making have been studied in depth for the past century. More recent research has revealed that feedback is a primary element in the decision making process. Feedback has been categorized according to its role in decision making. Some categories of feedback include cognitive, feedforward, and outcome. Cognitive feedback may hold the most promise for positively affecting the decision making process.

Naval Intelligence analysis is a complex process which involves human judgement and decision making on a daily basis. This thesis sought to determine that cognitive feedback would enable intelligence analysts to make optimal choices more consistently than if they were presented with just outcome feedback. Naval Intelligence analysts were the subjects of an unclassified experiment which captured a realistic task performed routinely by analysts in the Fleet. The experiment revealed that cognitive feedback produced the most accurate and optimal results, and indicates that intelligence analysis would benefit from decision support systems that incorporate the element of cognitive feedback.

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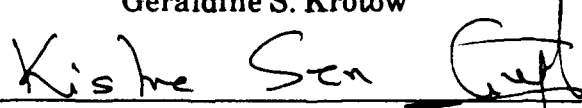
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ABSTRACT

Human judgement and the process of decision making have been studied in depth for the past century. More recent research has revealed that feedback is a primary element in the decision making process. Feedback has been categorized according to its role in decision making. Some categories of feedback include cognitive, feedforward, and outcome. Cognitive feedback may hold the most promise for positively affecting the decision making process.

Naval Intelligence analysis is a complex process which involves human judgement and decision making on a daily basis. This thesis sought to determine that cognitive feedback would enable intelligence analysts to make optimal choices more consistently than if they were presented with just outcome feedback. Naval Intelligence analysts were the subjects of an unclassified experiment which captured a realistic task performed routinely by analysts in the Fleet. The experiment revealed that cognitive feedback produced the most accurate and optimal results, and indicates that intelligence analysis would benefit from decision support systems that incorporate the element of cognitive feedback.

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I. INTRODUCTION

A. BACKGROUND

Research on decision making has revealed the role of feedback in affecting the decisions of individuals (Hogarth, 1987). Feedback affects the choice that a decision maker will make, and can be a crucial element in the decision making process, as it affects both the task environment and the decision maker's perception of the environment (Hogarth, 1987).

Feedback can be categorized into several different types, including cognitive and outcome feedback. As described by Jacoby, et al, 1984,

> ...outcome feedback is information that describes the accuracy or correctness of the response, cognitive feedback represents information regarding the how and why that underlies this accuracy.

A type of feedback which has shown beneficial results is cognitive feedback (Balzer et al, 1989). Cognitive feedback may have particular utility in a complex, probabilistic environment, where pertinent information, provided to the decision maker in a timely fashion, can lead to improved decisions. An example of such an environment is military intelligence analysis. The examination of the effects of cognitive feedback on intelligence analysts may lend validation to current beliefs about cognitive feedback, and

raise additional questions which, when answered, could provide a basis for future intelligence decision support systems.

B. EXPERIMENTAL TASK

To best capture the effects of cognitive feedback on intelligence analysis, a task specifically designed to capture the analysis process of analysts in the Navy was devised. The task was presented to active duty Naval Intelligence analysts in a format similar to what is used in the Fleet. The entire experiment was unclassified, and the geopolitical scenario was fictitious, yet effort was taken to design a realistic task environment that the analysts would be familiar with.

C. RESEARCH QUESTION

Previous studies of military intelligence analysts have revealed that analysts will tend to seek confirmation of their decisions (Tolcott et al, 1989). If this confirmation can be provided in the form of cognitive feedback, will the analysts use the feedback to reach more correct and optimal decisions? Does the form of feedback matter, or will there be a noticeable variance between subjects provided with and without cognitive feedback? Answers to these questions were sought through the design and implementation of the experiment, and were the focus of this research.

Analysts were randomly divided into two groups: cognitive feedback and outcome feedback. Each group was presented with

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the same exact task, but the information presented as feedback varied, dependent upon which group the analyst was assigned to. The results of each group were compared to one another, and the effects of different types of feedback on the analysts decisions were collected.

D. CONTRIBUTION

The importance of the decision making process to intelligence analysis is recognized, and the need to determine which types of feedback are optimal has been previously stated (Thompson et al, 1984). This research attempted to further determine if cognitive feedback is relevant and beneficial to the process of intelligence analysis.

Chapter II provides a literature review of research in the area of intelligence analysis, and lays the theoretical premise for the study. Chapter III describes in detail the experimental method. Chapters IV and V discuss statistical results of the experiment and conclusions drawn from the experiment, respectively. Results of this study and any follow-on studies may be used to develop more advanced decision support system prototypes for the Naval Intelligence and other military intelligence communities.

II. THEORETICAL PREMISE

A. THE DECISION MAKING PROCESS

1. Complexity

Human decision making is a complex process. Studies of this process have revealed that the complexity of decision making is dependent upon many individual factors such as intuition, anticipatory tendencies, and judgemental heuristics (Hogarth, 1987). A large portion of the decision making process involves human memory and the capability, or lack thereof, of the human mind to process information (Hogarth 1979).

The human being is a fallible decision maker (Hogarth 1979). The human mind is unable to effectively process continuous information from a multitude of sources, especially in a stressful environment. A stressful environment places the human mind in a position to ignore some information and process other information, dependent upon existing heuristics (Hogarth, 1987). In applications where decision making is vital, such as diagnostic medicine and tactical military scenarios, it is imperative that the information assigned the least importance is indeed worthy of such a low value.

Each piece of pertinent information contributing to a decision must be appropriately presented to the decision maker

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in a manner that will ensure the information is processed with due value. It is beneficial to fully u..derstand the importance of information presentation in the decision making process. This understanding can be accomplished by studying various decision models as described in subsection II.A.2.

2. Decision Making Models

Researchers have attempted to capture the human decision making process through observation and mathematical modeling. Two models of decision making are the conceptual judgement model (Hogarth, 1987) and the lens model, as described by Brunswick (Libby, 1981). The conceptual judgement model and the lens model appear to approach the task of decision making from the different aspects of psychology and mathematics. Yet the two models are inextricably linked by the element of feedback, a vital part of the decision making process. Section II.C identifies and defines feedback and its varieties in more detail. By examining each of these models a point of departure for this study was attained.

a. Judgement Model

Hogarth's conceptual judgement model divides the process of decision making into seven basic steps: (1) task environment, (2) Schema, (3) Acquisition, (4) Processing, (5) Output, (6) Action, and (7) Outcome. Step (7), outcome, provides information that will be pertinent to future decisions. This outcome of the decision making process is

also considered a form of feedback for future judgmental scenarios. Hence outcome, or feedback, is a means by which future judgements can be affected. In becoming pertinent information to the decision making process, feedback establishes its vital role in the decision making process.

The conceptual model of human judgement is depicted in Figure 1. Feedback plays a crucial role in the judgement process, as it provides criteria to both the task environment and the judgement schema. The lens model as interpreted by Brunswick continues the description of the element of feedback in mathematical detail.

b. The Brunswick Lens Model

The Brunswick Lens Model allows the environment to be observed through a "lens of imperfect cues" (Libby, 1981), and assigns weights to each of the cues in a specific decision making scenario. The Lens Model is readily adapted to situations in which the decision making occurs in a probabilistic environment, and the accuracy of a decision is contingent both on the individual decision maker and the environment in which the decision is made (Hogarth, 1987).

The lens model, as depicted in Figure 2, represents the differences between actual value weights assigned to pieces of pertinent information by the environment, and the value weights assigned to the pertinent
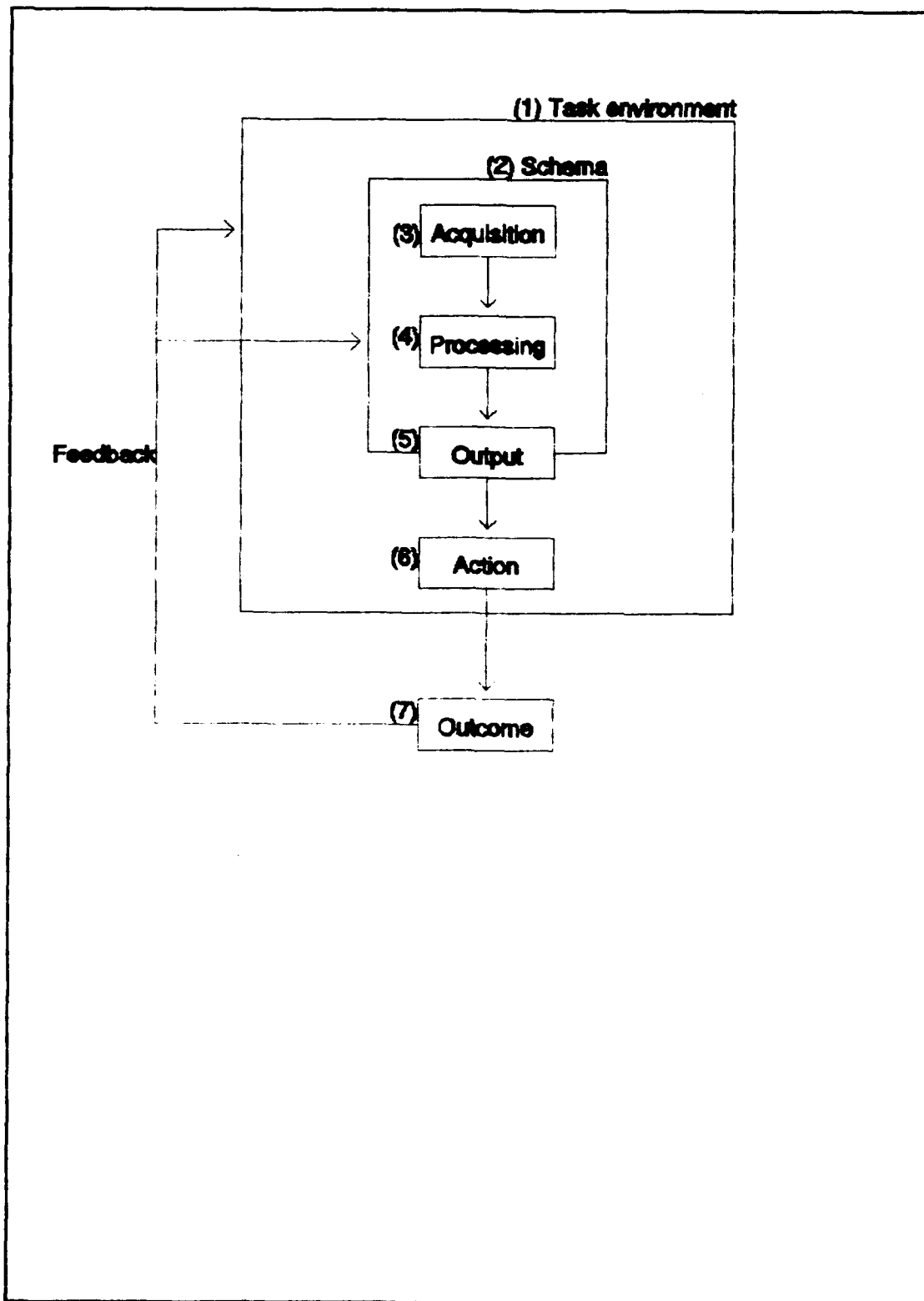
Figure 1.   Conceptual Judgement Model (Hogarth, 1987)

pieces of information by the decision maker. These pieces of information which are considered pertinent to a specific decision, or task, are formally referred to as cues.
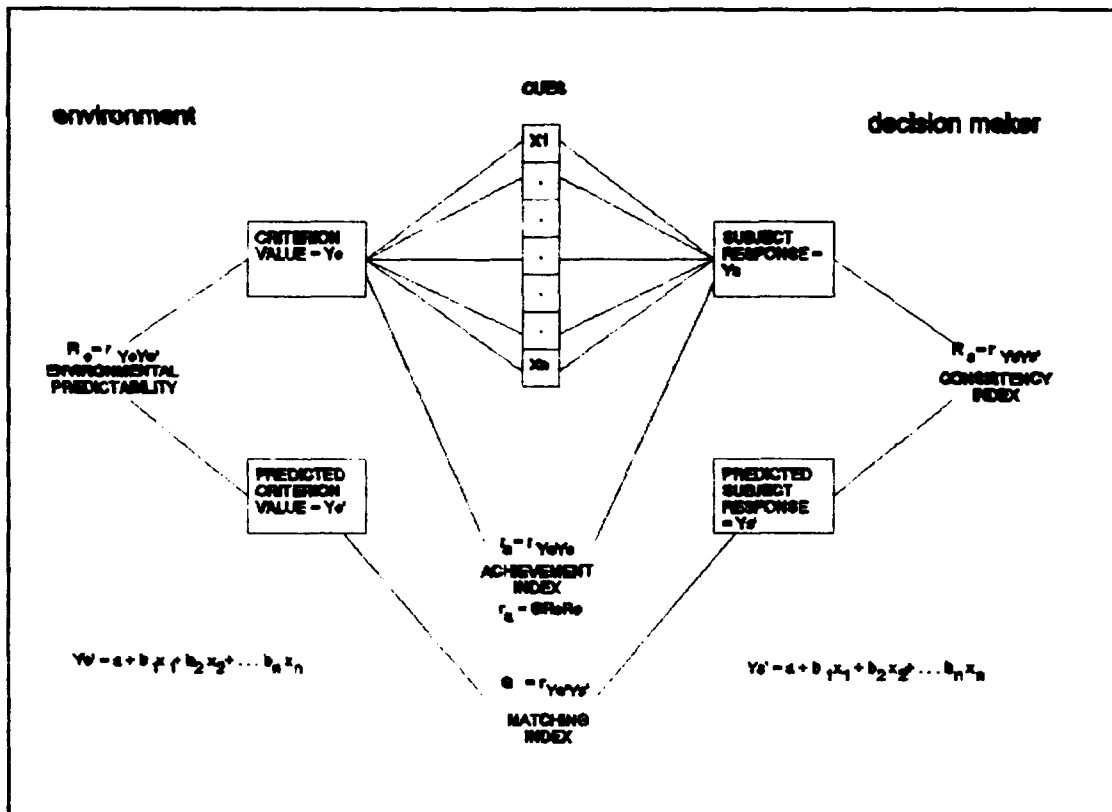
Figure 2. Brunswick Lens Model (c.f. Dudycha and Naylor 1966; Libby 1981).

The lens model uses identical polynomial equations for each side of the model; the environment and the decision maker. The differences lie in the assigned values, or weights, for each of the cues. All of the variables used by the lens model are listed and defined in Table 1.

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TABLE 1. LENS MODEL VARIABLES (c.f. Libby, 1981)

Symbol	Name	Definition
R_e	Environmental Predictability	$R_{Y_eY_e'}$
R_s	Predictability	$R_{Y_sY_s'}$
G	Matching Index	$r_{Y_e'Y_s'}$
r_a	Achievement	$r_{Y_eY_s}$

First, the lens model attempts to capture the status of the environment. The environment is represented by equation 1.

$$Y_e = a + b_1x_1 + b_2x_2 + \ldots b_nx_n$$

(1)

Y_e, the actual model imposed by the environment, is a compilation of the weights $(b_1\ldots b_n)$ assigned to the cues $(x_1\ldots x_n)$ by the environment. Likewise, the decision maker's view of the task is captured in an identical equation, Y_s, with the weights $(b_1\ldots b_n)$ assigned to the cues $(x_1\ldots x_n)$ by the decision maker.

Both the environment and the decision maker are using the same set of cues, $(x_1\ldots x_n)$, to which weights are then assigned. In the most ideal situation, the decision maker employs consistent weights for specific cues, dependent upon the nature of the task.

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Other factors that affect the decision-making process and are thus represented in the lens model include consistency and environmental noise. Environmental noise is also referred to as predictability (Libby, 1981). Both consistency and predictability utilize similar variables in their calculations.

R_s, consistency, measures how consistent the decision maker is in predicting the environment. It is calculated by a multiple correlation between the cues and the decision maker's judgements.

R_e, predictability, measures how predictable the environment is. If noise or predictability is low, the probability of the decision maker attaining a reasonable task accuracy is low (Libby, 1981). Predictability can be calculated by employing a multiple correlation of the cues and the actual environmental values.

The accuracy of decisions can be measured through the lens model, in the form of decision achievement, r_a.

$$r_a = G R_e R_s$$

(2)

Consistency, R_s, and predictability, R_e, can be calculated to determine the overall accuracy of the decisions made by the decision maker. Decision achievement is an indication of how

well an individual, Y_s, matches the environment, Y_e, through this "lens of imperfect cues" (Libby, 1981).

The Brunswik Lens Model lends well to the process executed by Naval Intelligence and Cryptological analysts. By examining the analyst's decision and mathematically comparing it to the environment's actual outcome, an index of achievement for intelligence analysts can be arrived at for a specific type of analysis task. The effects of various factors, such as feedback, on the decision making process, can be examined by comparative analysis of achievement indices for multiple instances of a generic task.

B. INTELLIGENCE ANALYSIS AS A DECISION MAKING PROCESS

While intelligence analysis can be a complex decision making process involving human judgement, intelligence analysis has not been "intensively investigated by psychologists for more than thirty years" in the manner human judgement and decision making have been (Tolcott et al 1989). A preliminary literature review reveals somewhat sporadic research in the area of intelligence analysis, with the majority of the material focused on developing decision support aids for the intelligence analyst.

In 1974 Patten attempted to initiate a method of organizing data and information received by an intelligence system to help analysts. Patten's concern was the following:

[that] intelligence analyst[s] working on specific problems must be able to selectively obtain information relevant to a specific problem without becoming bogged down in irrelevant information." (Patten, 1974)

Patten's study focused on the information and data relevant to the analysis process, but not the analysis process itself. Sticha, Patterson, and Weiss researched and determined Approximate Reasoning Methods for Decision Aids in 1982, which led to the development of a prototype decision aid for Air Force target nomination. The reason for studying approximate reasoning methods was to hopefully "...achieve a system that could facilitate an intelligence analyst's efforts" (Sticha et al, 1982). Hence, the actual intelligence analysis process became the focus of the research.

An Intelligence Aid for Estimating Enemy Courses of Action (AI/ENCOA) was developed in 1985 in an attempt to provide cognitive support to intelligence analysts by altering decision rule bases (Lehner et al 1985). AI/ENCOA software was developed as a prototype decision aid to assist Army tactical intelligence analysts assigned with choosing feasible enemy courses of action. This prototype utilized Multi-Attribute Utility (MAU) models and enabled the analyst to assign weights to each alternative.

Another decision support software package created for Army intelligence analysts was DINAA: The Dynamic Intelligence Assessment Aid, by Probus and Donnell, in 1986. DINAA allowed the analyst to determine probabilities for each avenue of

approach as determined by AI/ENCOA. DINAA utilized Bayes' theorem to adjust and assess probabilities. The Prototype Analyst Workstation (PAWS) developed in 1990 was similar to AI/ENCOA in that it allowed the analyst to define alternative courses of action open to the enemy, with the aid of MAU (D. Thompson et al, 1990).

Cohen, Laskey, and Tolcott developed a prototype decision aid in 1987 that could be personalized for each user. Submarine commanders were used as the subjects, and the idea that

> individual decision makers differ both among themselves and from task to task in the decision strategy they prefer (Cohen et al, 1987)

was examined. This "personalized and prescriptive" decision aid allowed the submarine commander to examine different decision methods, weights, and trade-offs for each decision.

Tolcott, Marvin and Lehner conducted research in 1989 in "...an attempt to further the investigation of cognitive behavior underlying intelligence analysis" (Tolcott et al, 1989). This study revealed that an intelligence analyst will tend to "[remain} with [his/her] original estimate" of a scenario, regardless of update information presented (Tolcott et al, 1989). It appears as though military intelligence analysts will "...pay more attention to supportive than to contradictory evidence," as it pertains to their original decision/estimate (Tolcott et al, 1989). This research

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elicited another research question: if update information could be defined as feedback, and if feedback could be further delineated into different types of feedback, would an analyst's perception of update information, or feedback, be affected by the specific type of feedback provided? This question is addressed in section II.C, *Feedback and its Role in the Decision Making Process*.

1. Decision Making and Intelligence Analysis

The process of intelligence analysis is comparable to the standard decision making process but even more pronounced due to the high levels of stress, dynamic environments, and the crucial nature of the decisions arrived at. After evaluating large amounts of incoming data (Adelman et al, 1984), the analyst must "provide information on which commanders' decisions are made," validating the analysts' position as a critical one in the chain of intelligence and operational events (Lewis and Copeland, 1982). It is clearly recognized that the analyst routinely faces an intricate and complex task that may be gargantuan in its proportions (Luckie et al 1968). Essentially, the analyst is tasked with repeatedly "quantifying assessed probabilities" (Probus and Donnell, 1986). Very often, the analyst is relying solely on intuitive feelings, with little or no substantiated feedback on his/her decision making process.

2. Intelligence Analysis as a Process

Naval Intelligence analysis utilizes the decision making process. Intelligence analysis can therefore be studied with the lens model and conceptual judgement model, and may yield improved performance results with the provision of feedback to the analyst. Effective intelligence analysis can be defined as an internal, concept-driven process vice an external, data-driven process (Katter et al, 1979), and thus, as an internal process, has the needs of conceptual judgement, including feedback (Hogarth, 1987).

> The intelligence analyst is continually faced with making probability assessments concerning both categorical events and events which lie along a continuum (Barclay and Randall, 1975).

Therefore the decision making process used by the analyst could be ideally studied with the aid of Brunswik's interpretation of the lens model.

C. FEEDBACK AND ITS ROLE IN THE DECISION MAKING PROCESS

> Technically, feedback is the process by which an environment returns to individuals a portion of the information in their response output necessary to compare their process strategy with a representation of an ideal strategy (Balzer et al, 1989)

Feedback, as pictured simplistically by Hogarth in his conceptual judgement model, is essential to the decision making process. Feedback is relevant to the decision making process and it is widely accepted that

> Better performing individuals would be more likely to access and use feedback information (Jacoby et al, 1984)

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It is fair to conclude from this that feedback could play an important role in improving intelligence analysis. There are many varieties of feedback, such as outcome and cognitive. What types of feedback will best suit the process of intelligence analysis? The answer becomes clear when the two most basic types of feedback, outcome and cognitive, are examined.

1. Outcome Feedback

Outcome feedback is the most basic type of feedback, and can be described as the results of a decision process that has already occurred. The results are the outcome(s) of decisions previously made; hence outcome feedback of a current decision does not facilitate changing or altering the current decision. Outcome feedback provides information on previous decisions only; current decisions are unaffected by outcome feedback from their results. Outcome feedback has been challenged for its validity as a type of feedback, as it can only enhance future decisions vice the current decision making process (Balzer et al 1989). Several research studies demonstrate that outcome feedback may have little to no utility in an uncertain learning environment (Balzer et al 1989). Hence, outcome feedback may not be optimal in the intelligence analysis environment, as intelligence analysis frequently occurs in an uncertain environment.

2. Cognitive Feedback

Cognitive feedback provides the decision maker with information about the decision currently being made. Cognitive feedback allows the decision maker to know what their consistency rating is, what weights they have assigned to cues, and what weights the environment has assigned to the cues. Cognitive feedback consists of three elements; Task Information (TI), Cognitive Information (CI), and Functional Validity Information (FVI) (Balzer et al 1989). Cognitive Feedback provides what outcome feedback cannot: information on the decision making process as it occurs. "Whereas outcome feedback is information that describes the accuracy or correctness of the response, cognitive feedback represents information regarding the how and why that underlies this accuracy" (Jacoby et al, 1984).

Naval Intelligence analysis occurs in a very dynamic environment. Since it has been suggested that outcome feedback is dysfunctional in a dynamic environment (Jacoby et al 1984), and that the type of feedback believed to be most beneficial, most often, is indeed cognitive (Balzer et al 1989), perhaps the feedback with the highest utility for Naval intelligence and cryptological analysts could be cognitive feedback. Cognitive feedback appears to hold promise for improving the quality of intelligence analysis. This could be of the utmost importance since many decisions made by analysts can affect the safety and lives of others.

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D. HYPOTHESES

> Because of the importance of decision making
> in intelligence analysis, it is imperative
> that more research be devoted to the types of
> decisions that analysts have to make...what
> are optimum feedback mechanisms? (Thompson et
> al, 1984)

This research examined the following hypotheses in an effort

to answer the previous question:

Cognitive feedback is more effective than outcome feedback
in intelligence analysis tasks.

Intelligence analysts provided with cognitive feedback
during their decision making process will exhibit improved
performance and will make optimal vice satisficing
decisions.

The research question was examined through an experiment,

using Brunswik's interpretation of the lens model and

mathematical analysis.

It was imperative to first determine whether or not the

subjects were affected by cognitive feedback in any way.

Further analysis determined exactly how the analysts were

affected: positively, in that they were making more accurate

and consistent decisions; or negatively, in that they were

making decisions which were increasingly inaccurate and

inconsistent with previous decisions. The effect of cognitive

feedback on Naval Intelligence and Cryptological analysts was

the focus of this study.

III. METHOD

A. INTRODUCTION

Naval Intelligence analysts make complex decisions on a daily basis, whether their analysis is as an individual analyst for an operational command such as a squadron or ship, or they are part of a large watchstanding team that collectively analyzes data for the Department of Defense (DOD). Naval Intelligence analysis routinely involves complex decision making and provides a viable arena for examining the effects of cognitive feedback on complex decision making processes.

The research question was investigated in an experimental setting designed to most closely represent the type of decisions made by analysts in the Fleet. A realistic and fairly complex task of moderate to difficult complexity was created in an effort to employ the broadest range of the analyst's decision making capabilities.

B. Experimental Design

An experiment involving comparison of results between two sets of subjects was devised. One set of subjects (12 subjects) was given outcome feedback only; another set (12

subjects) was given cognitive *and* outcome feedback. The presentation of feedback was designed to provide an optimal amount of information to the subject with minimal complexity in the presentation format.

The subjects for each part of the experiment were randomly assigned to receive outcome or outcome and cognitive feedback. Subjects receiving cognitive feedback had a longer instruction set to read and understand before they were able to begin the experiment. Outcome feedback was presented as accuracy, whereas cognitive feedback was presented as **Decision Support Information.** Both types of feedback, and how they were designed and presented to the subject, are described in the following sections.

C. PARTICIPANTS

Subjects chosen for this experiment were all on active duty in the United States Navy. They are currently serving, or have served, in positions requiring intelligence or cryptologic analysis. Both Enlisted Personnel and Commissioned Officers were used in the experiment. All subjects have received training by U.S. Navy schools, and have had experience at making intelligence decisions. The actual positions and billets held by the experiment's subjects varied, from operational intelligence billets afloat, to standard administrative-type billets ashore.

TABLE 2. EXPERIMENT SUBJECT DEMOGRAPHICS

Demographic	Mean	Standard Deviation
Age (years)	29.0	7.0
Rank (E-1 through O-9)	9.0 (E-9)	3.7
Analysis Experience (years)	5.5	4.6
How long since conducted analysis in the Fleet (years)	1.5	0.9

The subject demographics were calculated with the assistance of Minitab (Schaefer and Anderson, 1989).

D. TASK

The task of "quantifying assessed probabilities" (Probus and Donnell, 1986) to various cues or pieces of information is central to the intelligence analyst's decision making process. This is academically and professionally acknowledged as a difficult task, and has been examined and incorporated into the development of different systems to aid intelligence analysis, such as The Dynamic Intelligence Assessment Aid (DINAA) designed by Probus and Donnell in 1986; and described in the User's Manual for the Prototype Analyst Workstation (PAWS) by Thompson, et al, in 1990. Both DINAA and PAWS represent attempts to first capture, and then aid, the process of intelligence analysis. This highlights the first challenge faced when attempting to prove the hypothesis of this study: the experiment must include a task similar in complexity to

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the task performed by a Naval Intelligence analyst on a daily basis. The validity of the experiment hinged upon the data collected from the analysts, and the data could only be as realistic and meaningful as the task itself.

1. Selection of Task

The task of intelligence analysis requires the analyst to provide a decision based upon whatever information is available. To represent this task and ensure the robustness of the experiment, a task similar to that performed by analysts in the Fleet was devised. The task requires the analyst, or subject, to provide his/her best estimate of a suspect ship's position, based upon given information. The given information was dependent upon whether or not the subject had access to solely outcome feedback, or cognitive *and* outcome feedback.

2. Description of Task

The actual task presented to the analysts involved an anti-drug smuggling situation. Anti-drug smuggling tasking was chosen due to its relevancy in military operations and intelligence. The task was first presented to the analyst from a political standpoint of the situation in the **Background Information**. The **Background Information** provided current domestic and international political and social information as it pertained to the influx of illegal drugs into the United States. The purpose of the **Background Information** was to

create a basis of familiarity for the analyst, and to give the task a realistic perspective.

The task was reduced to a single situation, similar to the analysts daily tasks in the Fleet, in the **Situation Report** and **Scenario**, both which narrowed the scope of the illegal drug trafficking trade to a single suspect vessel. The analyst was asked to provide his/her best estimate of the location of the suspect vessel based upon the information provided.

Basic information provided on the suspect vessel included that it had completed three previous runs from Colombia to the U.S. over the past six weeks, tracking east of Cuba the first time, and west of Cuba the last two times. The analyst was told the vessel was estimated to carry up to three tons of cocaine, and that it was preparing to depart Colombia once again for the U.S. mainland. This basic information on the suspect vessel provided the analyst with a brief history of the vessel, the general geographic location of the scenario, and an idea of the vessel's drug carrying capability.

3. Task Variables/Cues

A realistic task necessitates variables and random weighting of the variables. This task incorporated four variables: weather, ship type/speed, presence of the Cuban Navy, and the last contact information on the suspect vessel.

All four variables were present throughout the task; thus the analyst had information regarding each of the four variables each time he/she was asked to perform the task of providing an estimated suspect vessel position. Each variable appeared to be weighted differently in each scenario presented to the analyst, and the combination of the differently weighted variables varied as well. This was to provide as realistic a task as possible, and to optimally test the analysts decision making capabilities. However, the actual position of the ship, as calculated by the system, weighted the ship type/speed, weather, and last contact variables equally and included a random error. The proximity of the Cuban Navy variable was negligible in the calculation of the ship's actual position. The values used for each of the variables as presented to the analysts are represented in Table 3.

TABLE 3. EXPERIMENTAL CUE CHARACTERISTICS

Variable	Values
Last Contact	1-12 hours
Ship Type/Speed	Sailboat (6-8 knots) Yawl (10-12 knots) Cargo Ship (19-20 knots) Speedboat (40+ knots)
Sea State	1 = Calm, winds up to 10 knots 2 = Breezy, winds up to 20 knots 3 = Heavy swells, winds up to 45 knots 4 = Hurricane force, gale winds up to 80 knots
Cuban Navy in Area	20 nautical mile radius 15 nautical mile radius 10 nautical mile radius 3 nautical mile radius

E. PRESENTATION

1. Task Description/Information

All subjects, regardless of the type of feedback provided to them, received the same basic information to enhance the naturalness of the experiment. **Background Information** and **Situation Report** provided geopolitical information on the areas of concern for DOD and the United States Government. In this experiment, **Background Information** stated that the focus of the President is on the anti-drug efforts of the U.S. This set the stage for the scenario in which the subject was asked to provide a position for the

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suspect vessel. Scenario provided information as to what billet the subject was to place him/herself in, and for what purpose they were to provide an estimated position of the suspect vessel.

In keeping with the experimental rule of "ten scenarios per cue" (Balzer and Doherty, 1991), the analyst was asked to provide an estimated position of the suspect vessel forty separate times during the experiment. Each scenario was independent of any other, and incorporated the four variables, or cues, provided to the subject. The four variables were last contact, ship type/speed, weather, and Cuban Naval exercise proximity to the location of the suspect vessel. The actual values of each variable (hours, knots, sea state, proximity of Cuban Navy in nautical miles) were varied in each scenario. Thus each scenario used the same four variables, but in a different combination of values for each instance.

Variables were presented to the analysts in the form of message sets, which are very familiar to intelligence personnel. An example of a message set is in the Appendix.

Since the entire experimental scenario and background information was unclassified, so were the message sets, the origin of each message, and its destination.

The four variables; last contact, ship type/speed, weather, and Cuban Naval activity proximity to the suspect vessel, were all presented in the message set. The analyst was presented with forty message sets in total, each formatted

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identical to the sample message set in the Appendix, but with the values of the cues, or variables, randomly varied.

2. Geographic Representation

The task was designed to best represent the tasks performed by analysts on a daily basis in the Fleet. The task asked the analyst for his/her best estimate of the suspect vessel's position, based upon the information presented in the respective message set. In a real situation, the analyst would be asked to provide an estimated position in degrees latitude and longitude. To provide a more straightforward representation of the task and also to place necessary limits on the pertinent geographic area of the task, a grid square was designed to cover the geographic area of the experiment.

The analyst was asked to locate the suspect vessel in an area in the Caribbean, north of Colombia and Venezuela. The geographic area of the task is depicted in the Appendix. The grid square was bounded by the following four coordinates: 12N 72W; 18N 72W; 12N 78W; 18N 78W. The grid square was divided into thirty-six smaller squares, and each square was approximately sixty by sixty nautical miles. Each square was assigned a two-digit, unique number. This allowed for greater ease in providing a position, and thus greater ease in calculations involving the positions of the suspect vessel. The grid square did not, however, detract from the continuous nature of the latitudinal and longitudinal scales of

measurement. Continuous values for the position(s) of the suspect vessel were preserved with the grid square as each position remained unique and numerically higher or lower than any other grid square. The grid square numbering maintained the continuity of the number line.

What was most realistic in the experimental setting was that the message sets presented multiple cues to the subjects in a format familiar to the subjects. This enhanced the viability of the results captured by the experiment, as it allowed the analysts to complete a task as familiar as possible to them. Experiment debriefing revealed that nearly every subject believed the experiment and task to be highly realistic and believable.

F. SETTING

Subjects received experiment **Background Information, Scenario, Situation Report, Message Sets, Computer Instruction Set,** and **Decision Support Information** manually, in a loose-leaf binder. The experimenter presented the subject with the binder after briefly explaining the geographical area of the experiment with the aid of a navigational chart. **Background Information, Scenario, Situation Report,** and **Message Sets** were described in sections III.D and III.E. **Computer Instruction Set** and **Decision Support Information** will be described in this section, and section III.G, respectively.

1. Geographic Area

A navigational chart identical to those used in the Fleet by analysts conducting actual tasks was provided, with the task area delineated in grid format. Thirty-six squares, approximately 60 nautical miles X 60 nautical miles each, were numbered to represent a continuous scale similar to latitude and longitude. Each square was unique. The grid-square numbering system allowed for greater ease in statistical analysis without detracting from the actual continuous latitude/longitude system employed in the Fleet.

The geographic area of the experiment, defined by the grid square, was covered with acetate to allow marking of the area by the analyst with a water soluble marker. Rulers or navigational plotters/dividers were provided to the subject for distance calculation.

Each subject was provided with a piece of scrap paper and a pencil or pen for any time-distance calculations required. Calculators were not permitted as a general rule.

2. System

The experiment was conducted on IBM compatible 286/386 computers, in private office or computer laboratory areas. Each subject was given a one page Computer Instruction Set which explained the screen on which the vessel's estimated

position, in the form of a grid square number, would be entered. Instructions on how to receive outcome or cognitive feedback were included in the appropriate instruction set.

Additional computer instructions were presented to the subject on the screen of the computer they were using, reminding the analyst to consider each message set individually, and to enter each two-digit estimated position of the suspect vessel into the computer after they had analyzed each message set. The last instruction on the screen directed the subject to "strike any key when ready," upon which time the four-column screen for position entry was displayed on the monitor.

3. Data Capture/Entry

The system captured the subject's estimated positions when the subject entered their estimated position for each message set. The subject was presented with a monochrome screen with four columns of ten entry places each. To the greatest extent possible, a graphical display was used that had been found to be effective for approximate comparison of quantitative information (Brehmer, 1984). The entry places for the subject's estimated positions were numbered 1-40, and further computer instruction information was presented on the bottom line of the screen. The columns for data entry covered the bottom-half of the screen. The top-half of the screen remained blank for subjects receiving outcome feedback

only. When the subjects receiving solely outcome feedback pressed "END," they were presented with the actual position of the the suspect vessel (accuracy, or r_a,) in the right hand columns next to their estimated vessel position.

The subjects receiving cognitive feedback were presented with a menu after they pressed "END." The menu was displayed in the top half of the screen. After choosing a cognitive or outcome feedback option, the subject participating in the cognitive feedback experiment was provided with decision rule scales in the top half of the screen, or consistency and/or accuracy information in the columns preceding or following the estimated position entry column.

An experimenter was present for the entire length of the experiment, to provide guidance to the subjects and ensure proper task completion by the subjects. The subjects were given no time limit for completing the forty tasks involved in the experiment. Subjects took anywhere from 50 minutes to 135 minutes to complete the experiment.

G. DESIGN OF FEEDBACK

1. Outcome Feedback

In the experiment version that incorporated outcome feedback only, the computer instruction set indicated that the analyst could access outcome feedback, in the form of the suspect ship's *actual* position, by pressing the "END" key on the keyboard. Once the subject had accessed outcome feedback,

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he/she was unable to change any positions he/she had already entered.

In the experiment incorporating both outcome and cognitive feedback, the analyst was able to access their accuracy, or outcome feedback, by selecting the "accuracy" menu choice on the feedback menu.

Outcome feedback was presented in similar fashion to the subjects for both sets of the experiment. When the subject accessed "accuracy," the outcome feedback was displayed, in the form of a two-digit suspect vessel position, as estimated by the system. The system's estimate of the suspect vessel's position appeared in the right-hand column of the data-entry screen, next to the suspect vessel's position estimated by the subject. The outcome feedback, in the format of "accuracy," is displayed in Figure 3.

Outcome feedback, or accuracy, was calculated with the use of consistency and predictability information.

2. **Cognitive Feedback**

All subjects conducting the outcome *and* cognitive version of the experiment received an additional instruction set, **Decision Support Information**, which detailed the five choices of cognitive, or "decision" feedback available to the analyst.

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```
MSG        Vessel
SET        Position
  1          34        35
  2          22        21
  3          25        23
  4          53        54
  5          45        44
  6          43        43
  7          57
  8          56
  9          98
 10          99
```

Figure 3.   Outcome Feedback Displayed as Accuracy
(Sengupta, 1990)

To access both cognitive and outcome feedback, the analyst pressed the "END" key, which then provided them with a menu of information feedback options. Choices numbered 1 through 5 on the menu provided cognitive feedback information. Choice number 6 provided outcome feedback, in the form of accuracy, as described in the previous subsection.

The experimental model required that the analyst had provided positions for at least 15 message sets before any of the cognitive feedback options could be accessed. Cognitive feedback information was presented to the subject in the following formats:

1. Decision Rule Information: This provided specific weights assigned to the variables by the analyst for the previous scenarios which the analyst had provided an estimated

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position for. This function would reveal to the subject which of the variables they were placing the most and least values on to make their decision. The calculation of the weights assigned to the variables was accomplished by the following method (as in Sengupta, 1990):

(a) Weights assigned to the variables were calculated by a multiple regression of variable values and the analyst's estimation of the weights.

(b) The weights were then transformed into a percentage representation of the total value of the weights.

(c) The weights, transformed into percentages, were then displayed on a horizontal bar graph as shown in Figure 4.
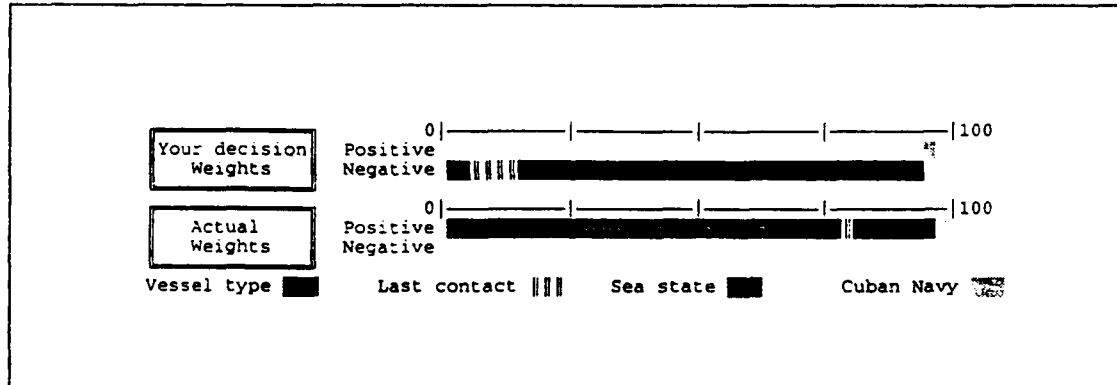
Figure 4. Analyst's Decision Weights (Sengupta, 1990)

2. Consistency Information: This function provided the subject with the positions they would have chosen for the suspect vessel if they were indeed applying their decision rule consistently. As with choice one, Decision Rule

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Information, only the message sets for which the analysts
had provided an estimated position could be given
correlated consistency positions. Consistency was
calculated by a multiple correlation between the variables
and the analyst's estimation of the weights of the
variables. Consistency was presented to the analyst on
the data entry menu, in the left-hand column next to the
analyst's estimated suspect vessel positions. An example
of the presentation of consistency is depicted in Figure
5.

MSG SET		Vessel Position	
1	34	34	35
2	21	22	21
3	25	25	23
4	52	53	54
5	46	45	44
6	40	43	43
7	57	57	
8	55	56	
9	88	98	
10	93	99	

Figure 5.   Consistency Information (Sengupta, 1990)

3. Information on the System's Decision Rule: This function
   provided the subject with the actual weights for each
   variable, or cue, as applied by the system, to achieve the
   correct, or system, answer.   This was calculated in a
   manner similar to Decision Support Information, but the

multiple regression was between the actual weights of the variables, and the assigned values of the variables. Information on the system's decision rule was represented on a horizontal bar graph.

4. Information on the System's and the Subject's Decision Rule: a combination of choices one and three, this function allowed the subject to graphically compare his/her applied decision weights with the weights utilized by the system.

5. Information on the Subject's Decision Rule and Consistency: a combination of choices one and two, this function presented the subject with both the weights he/she was utilizing, as well as his/her degree of consistency.

6. Accuracy: this function served as the outcome portion of this version's feedback, as it provided the subject with the actual vessel position. As in the outcome feedback only version of the experiment, once the subject accessed accuracy, or outcome feedback, he/she was not able to revise any previously entered vessel positions.

IV. EXPERIMENTAL RESULTS

A. TASK RESULTS

The statistical analysis of the experiment supports the hypotheses by revealing that the analysts presented with cognitive feedback *and* outcome feedback performed significantly better than the analysts who received outcome feedback only. Hence, cognitive feedback impacted the intelligence analysis process pertinent to the experimental task in a positive manner.

An immediate and clear measure of the performance of the analysts is represented in Table 4.

TABLE 4. MEANS AND (STANDARD DEVIATIONS) OF PERFORMANCE

TYPE OF FEEDBACK	r_a	R_s	G
Cognitive Feedback	.841 (.106)	.914 (.068)	.967 (.041)
Outcome Feedback	.658 (.192)	.811 (.077)	.717 (.180)

The measures of performance are the achievement index, or accuracy, r_a, the consistency index, R_s, and the matching index, G. In all three measures, the analysts receiving cognitive feedback performed markedly better than the analysts receiving outcome feedback only.

To more closely examine these results, an analysis of variance (ANOVA) amongst the performance factors was conducted. This was calculated using the General Linear Models procedure in SAS (SAS, 1987). The results are shown in Table 5.

TABLE 5. ANOVA OF MODEL AND (ERROR)

Dependent Variables	Degrees of Freedom	Sum of Squares	Mean Square	F Value	Pr > F
r_a	1 (22)	4.720 (1.904)	0.079 (0.019)	4.05	0.0001
R_s	1 (22)	0.624 (0.398)	0.010 (0.004)	2.56	0.0001
G	1 (22)	2.606 (1.968)	0.043 (0.020)	2.16	0.0003

The results indicate that subjects receiving cognitive feedback had a significantly higher achievement score than those receiving outcome feedback ($F(1,22) = 4.05$; $p < 0.0001$). Subjects receiving cognitive feedback had a significantly higher consistency score than those receiving outcome feedback only ($F(1,22) = 2.56$; $p < 0.0001$). Subjects receiving cognitive feedback also had a significantly higher matching index than those receiving outcome feedback only ($F(1,22) = 2.16$; $p < 0.0003$). We thus conclude that subjects receiving cognitive feedback performed better than those receiving outcome feedback only. The null hypothesis is, therefore, rejected. The statistical results of the ANOVA of the

performance indicators also support the hypothesis that cognitive feedback positively affects the performance of intelligence analysts.

B. DEBRIEF RESULTS

The debriefing questionnaires and task block surveys revealed information on the subjects perceptions of the experiment. Overall, the analysts found the task to be difficult, and felt that it moderately resembled a task they had previously performed in the Fleet. Subjects found the task to be clear, and took the experiment very seriously.

Analysts who received cognitive feedback found it to be moderately helpful, and all subjects felt that the outcome feedback (actual ship's position) was moderately helpful.

V. CONCLUSIONS

A. SUMMARY

The purpose of this study was to evaluate the efficacy of cognitive feedback in improving intelligence analysts' performance. The statistical results of the experiment indicate that analysts who received cognitive feedback did indeed perform better than their colleagues who received only outcome feedback.

B. CONTRIBUTION

Evidence thus indicates that cognitive feedback positively impacts performance. The significance of this study is that it involved U.S. Naval Intelligence and Cryptologic personnel, and indicates that cognitive feedback could be beneficial to more types of intelligence analysis. For example, intelligence analysts tracking a suspect vessel would be able to receive information on the significance of the cues in the particular environment in which they are working (environmental weights). Analysts could have, at a glance, a summary of the emphasis that they have been placing on various cues in a particular problem (decision weights). Analysts could also access information relating how consistent their choices are (consistency). One or all of these added tools to

the environment of intelligence analysis could be beneficial
and lead to improved analysis results.

C. FUTURE RESEARCH

Future research could use this study as a point of
departure to determine which forms of cognitive feedback are
most beneficial to intelligence analysis. This could lead to
the development of a Decision Support System prototype for
U.S. Naval Intelligence activities.

APPENDIX

NAVAL INTELLIGENCE OFFICERS: A LENS VIEW OF INTELLIGENCE
ANALYSIS

INSTRUCTION SET

A. Introduction

1. The purpose of this study is do examine how Naval
Intelligence Officers and Specialists process complex
information.

2. Your participation in this experiment is voluntary and
the results of your participation will be used for research
purposes only. Please take the experiment seriously and
attempt to answer the queries as realistically as possible.

B. Your Task

1. Your task involves three basic steps. They are:

a. Read the background information for your scenario
provided in your task booklet. You may need to read it over
two or three times before you feel thoroughly comfortable with
it. The scenario will provide information regarding the task
you are asked to perform. For example, you will be told the
history of a particular drug-smuggling ship that you will
later be asked to provided an estimated location for.

b. Examine, individually, each of the 40 message packages
provided. Each message set is on a separate piece of paper
and consists of three "messages" similar to those you use in
the Fleet. The scenario will take place in the Caribbean.
Each message set will provide information on the ship's
type/speed, the last contact (in hours), weather in the
Caribbean, and Cuban Naval presence in the vicinity of the
suspect vessel.
A typical message set is composed of three messages
whose bodies of information appear as follows:

"SUSPECT SHIP LOCATED 15 HOURS AGO IN THE VICINITY OF GRID
SQUARE # 373, TRAVELING AT 3 KTS."

"WEATHER REPORT FOR 15 JANUARY: CLEAR SKIES, WINDS FROM
THE WEST AT 10-12 KTS, NO WHITECAPS, MINIMAL WAVES."

"CUBAN NAVAL UNITS SIGHTED WITHIN 1 NM OF SUSPECT VESSEL."

     c. After you read and analyze each message set, you are to provide a grid square position number of where you best estimate the target unit to be located. You will use the chart provided and the navigation set to determine this.

     REMEMBER--each message set is independent of all others, hence you will estimate a new position for each message set.
    You will complete two blocks of 40 queries, for a total of 80 position estimates.

     d. This is a not a simple task and the answer may not seem "easy" to arrive at. Do not get discouraged, and remember that you were chosen for this experiment because of your expertise at decision-making in a complex environment.

2. Please read the computer instructions carefully. You will receive the scenario background information and message packages manually, and enter your estimated position into the computer. You may also be able to use the information on the computer to receive feedback on your decisions, and this will be specified in the computer instructions.

3. After you complete the entire task (both blocks), please fill out the debrief questionnaire and the demographic information sheet provided. Please be honest and as clear as possible in your responses. Turn your entire packet into the experimenter.

Cognitive Feedback
COMPUTER INSTRUCTION SET

* You will be presented with four columns on your screen. There are ten rows in each column, one for each message set, for a total of forty message sets per block.

* The message sets will be presented manually. Each set is on a separate piece of paper. The message sets incorporate information that will enable you to estimate the target ship's location. Specifically, you will be given information on the ship type/speed, last contact (in hours), weather, and Cuban Naval presence in the area.

* You can enter your grid square number choice for each message set next to the appropriate message set number. You need not analyze the message sets in any particular order. You can maneuver about the screen with the cursor. The "up" and "down" arrows allow you to select the message sets you choose to analyze, and also allow you to change answers if you choose to.

* At anytime during the experiment you may access decision support information on the accuracy your decision making process. Simply press "END" and a decision support information menu will be presented to you at the top portion of your screen. You may select up to six different types of feedback, but once you chose feedback that displays the accuracy of your decisions, you may not change any decisions already completed. You will receive further information on the decision support information and how to use it before you begin the experiment.

* All decision rule information requires that you have entered at least 10 positions before you can access this information.

* After you have completed Block One, complete the Block One Questionnaire and press "HOME" to move to Block Two.

* After Block Two, complete the Block Two questionnaire, the task debrief survey, the demographic information sheet, and inform the experimenter that you are finished.

* The line at the bottom of the screen will provide you with information on how to maneuver about the screen and how to receive additional information.

* IF AT ANYTIME DURING THE EXPERIMENT YOU ARE NOT SURE OF HOW TO USE THE PROGRAM, ASK THE EXPERIMENTER.

Outcome Feedback
COMPUTER INSTRUCTION SET

* You will be presented with four columns on your screen. There are ten rows in each column, one for each message set, for a total of forty message sets per block.

* The message sets will be presented manually. Each set is on a separate piece of paper. The message sets incorporate information that will enable you to estimate the target ship's location. Specifically, you will be given information on the ship type/speed, last contact (in hours), weather, and Cuban Naval presence in the area.

* You can enter your grid square number choice for each message set next to the appropriate message set number. You need not analyze the message sets in any particular order. You can maneuver about the screen with the cursor. The "up" and "down" arrows allow you to select the message sets you choose to analyze, and also allow you to change answers if you choose to.

* At anytime during the experiment you may find out what the correct answers were for message sets you have already completed. By pressing "END" you will be provided with the "correct" ship positions. Once you access this information, you may not change any answers you have already entered.

* After you have completed Block One, complete the Block One questionnaire and press HOME" to move to Block Two.

* After Block Two, complete the Block Two questionnaire, the task debrief survey, the demographic information sheet, and inform the experimenter that you are finished.

* The line at the bottom of the screen will provide you with information on how to maneuver about the screen and how to receive additional information.

* IF AT ANYTIME DURING THE EXPERIMENT YOU ARE NOT SURE OF HOW TO USE THE PROGRAM, ASK THE EXPERIMENTER.

BLOCK ONE

Background Information

The United States has been fighting the drug war for over three years, yet the effectiveness of the war is questionable. The Presidential election is only one year away, and the current administration wishes to ensure continual funding for the anti-drug effort.

World politics have taken a backseat to domestic issues. The current administration realizes that domestic policy has not been its strong suit in the press, as presented to the American people.   One issue that is repeatedly spotlighted by the media is that of the "crack babies" being born to cocaine addicted mothers, at an alarming rate. Crack babies are not just born in the inner-city ghetto atmosphere, but to mothers of all social strata in the U.S.   Recent news commentaries have revealed that the importation of cocaine and crack into the U.S. is at an all time high.   Congress is beginning to ask what is going on with the drug war.

Senior military officials know that their anti-drug campaign has been relatively successful and fruitful.   In light of the small number of U.S. armed forces dedicated to the anti-drug campaign, the total amount of captured contra-band is phenomenal.   But in comparison to the total amount of cocaine and crack smuggled into the U.S. annually, it is barely the tip of the iceberg.

The President saw a need to step up the intensity of the drug war.   He elicited advice from his top military personnel regarding just how much military hardware and personnel would be needed to accomplish this.   Then, the President went to Congress with the Secretaries of Defense and Transportation and presented a proposal to attempt to finally put a noose on the cocaine flow from Colombia, Bolivia, and Peru.   The country of chief concern is Colombia, since drugs harvested in Peru and Bolivia are transported through Columbia and then flown or shipped to the U.S.

Situation Report 10 November 1991

In a sweeping majority last week, Congress voted to increase the budget for the drug war ten-fold.   This increase was voted in under the conception of the American people that the war could now be tackled in a short period of time and put an end to the drug trade in the Caribbean.

Scenario

You are on watch in the Joint Team Against Drugs Command
in Florida. Pressure has been increasing for your watch team
to get the best intelligence possible out to the Fleet surface
and air units who are responsible for patrolling marked areas
in the Caribbean.

You have received intelligence indicating that a vessel
capable of carrying three tons of cocaine is preparing to
depart Colombia for the U.S. mainland. A history of this
vessel reveals that it has completed three runs from Colombia
to the U.S. in the last six weeks. Its tracks were around the
eastern edge of Cuba the first time, then around the western
edge the last two times. Track navigation took 4 days each
time.

You are directed to provide the most likely area the
vessel is at the current time. Taking into consideration the
information provided in the most recent message traffic, in
what area would you send the aircrews and ships? It is
currently 11 Nov and you need to estimate the vessel's
position. Please provide a grid square number where you best
estimate the suspect ship to be.

Decision Support Information

* What is Decision Support Information?

Decision Support Information is diagnostic information provided by the system on your decision processes and that of the system. You can access the decision support when making your decisions on the suspect vessel's positions. (In order to compute the information, however, the system needs at least 10 scores from you). By accessing such information, decision makers can derive better insight into their decisions processes. This enables them to revise and improve their decisions (or positions, in this case) through a "what-if" mode of analysis.

* How do I use Decision Support Information in Making Decisions?

Typically. you the decision maker, would use the decision support information as follows:

1.   Make some tentative decisions (i.e., ship's positions).

2.   Ask the system for decision support information.

3.   Refine your positions accordingly.

You may wish to do this 1-3 sequence within a block, as many times (and with as many scores) as you wish.
This sequence allows you to delay asking for your accuracy and enables you to continue to refine your positions.

* Types of Decision Support Information
(For illustrations of Decision Support Information, see III.G.2)

The system will provide you with the following 5 types of decision support information:

1.   INFORMATION ON YOUR DECISION RULE:

Decision makers are sometimes unable to specify precisely, a particular decision rule (in this case, weights assigned to specific information regarding the suspect vessel). The system will track the weights you are using (in

formulating your positions) and will display them through a stacked-bar chart.

How do I use it?

1. Make sure the weights displayed are actually the ones you want applied.

2. If not, revise your scores, and see how the weights change.

3. Iterate between 1-2 until the system shows weights you actually want applied.

2. INFORMATION ON YOUR CONSISTENCY:

Sometimes, after decision makers have specified their decision rules, they are unable to apply them consistently. The system will calculate the scores you would have given had you been completely consistent with your decision rule.

How do I use it?

1. Check your scores against the consistency scores.

2. Revise your scores if you need or wish to.

3. Iterate between 1-2 till your scores match with or are close to the consistency scores.

3. INFORMATION ON THE SYSTEM'S DECISION RULE:

Instead of trying to figure out from several examples what rule the system is using, it is more effective if it is displayed in a bar graph format.

How do I use it?

1. Use the information to get an idea of what decision rule the system has been following.

4. INFORMATION ON THE SYSTEM'S DECISION RULE AND YOURS

This is actually a combination of decision support information 1 and 3. It enables you to compare your decision rule with that of the system and thereby emulate the system better.

How do I use it?

1. Check weights you have given versus weights given by the system.

2. Revise your positions if you need to.

3. Iterate between 1-2 until your weights match with or are close to the system's weights.

5. INFORMATION ON YOUR DECISION RULE AND CONSISTENCY

This is actually a combination of decision support information 1 and 2. The idea here is to let you revise your weights without losing your consistency at the same time.

How do I use it?

1. Make sure the weights displayed are actually the ones you want applied.

2. If not, revise your positions, and see how the weights change.

3. Check your scores against the consistency scores.

4. Revise your scores if you need or wish to.

YOU ARE NOW READY TO PROCEED WITH THE TASK

MESSAGE SET ONE

FM: USS SPIKE
TO: JTAD
SUBJ: VESSEL SIGHTING

SUSPECT VESSEL SIGHTED BY FANTAIL LOOKOUT APPROX. 7 HRS. AGO, AT
GRID SQUARE #68, MOVING 18 KTS.

FM: NOAA
TO: JTAD
      USCOMSOLANT
SUBJ: WX REPORT FOR 11 NOV 1991

PARTLY CLOUDY SKIES WITH WINDS FROM THE NNW AT UP TO 45 KTS,
CAUSING HEAVY SWELLS AND WHITECAPS.

FM: USS SCUTTLEBUTT
TO: JTAD
      USCOMSOLANT
SUBJ: CUBAN NAVAL EXERCISE ACTIVITY

CUBAN NAVAL EXERCISE UNITS SIGHTED WITHIN 20 NM OF SUSPECT
VESSEL.

QUESTIONS TO BE ANSWERED AFTER COMPLETING BLOCK ONE

cognitive feedback

1. Describe (in words or equations) what decision rule you followed in making your own estimates:

_____
_____
_____
_____

2. Distribute 100 points among the three variable you used for reaching your overall estimate-in accordance with the importance you assigned them (total will add up to 100).

        Ship's speed   _____
        Ship's last contact _____
        Weather   _____
        Cuban Naval Presence_____
                     100   Total

3. What do you think the actual weights the system used for each of the variables was?

        Ship's speed   _____
        Ship's last contact _____
        Weather   _____
        Cuban Naval Presence_____
                     100   Total

4. In this task, did you request decision support information at any time from the system? Y N

5. If "YES", try to describe how you used decision support information in making your decisions.

_____
_____
_____
_____
_____

QUESTIONS TO BE ANSWERED AFTER COMPLETING BLOCK ONE

outcome feedback

1. Describe (in words or equations) what decision rule you followed in making your own estimates:

_____
_____
_____
_____

2. Distribute 100 points among the three variable you used for reaching your overall estimate-in accordance with the importance you assigned them (total will add up to 100).

        Ship's speed   _____
        Ship's last contact _____
        Weather   _____
        Cuban Naval Presence_____
                     100   Total

3. What do you think the actual weights the system used for each of the variables was?

        Ship's speed   _____
        Ship's last contact _____
        Weather   _____
        Cuban Naval Presence_____
                     100   Total

DEMOGRAPHIC SURVEY

NAME_____AGE_____SEX
_____

RANK_____DESIGNATOR_____

COMMISSIONING   DATE_____COMMISSIONING
SOURCE_____

YEARS IN INTELLIGENCE FIELD_____

PREVIOUS   OPINTEL   EXPERIENCE   (DUTY   STATION,   DATES)
_____
_____
_____
_____
_____
_____

A L L   O T H E R   P R E V I O U S   A S S I G N M E N T S
_____
_____
_____
_____

INTELLIGENCE SCHOOLS ATTENDED (NMITC BASIC, NMITC OPINTEL,
ETC)_____
_____
_____
_____
_____

FULL-TIME WORK EXPERIENCE (IN YEARS)_____

HIGHEST DEGREE EARNED: HIGH SCHOOL___   ASSOCIATE'S___
BACHELOR'S___ GRADUATE___   OTHER (SPECIFY)_____

HOW LONG AGO (IN YEARS) DID YOU COMPLETE YOUR HIGHEST LEVEL OF
EDUCATION? _____

HOW FAMILIAR ARE YOU WITH COMPUTERS, GENERALLY?

    1   2   3   4   5   6   7   8   9
Not at   Very
all familiar   familiar

HOW MANY HOURS PER WEEK DO YOU USE COMPUTERS?_____

YOUR GENERAL COMMENTS REGARDING THE EXPERIMENT:

_____

_____

_____

_____

TASK DEBRIEF SURVEY

Cognitive Feedback

1. How would you rank the difficulty of your task during the past 40 scenario snapshots?

```
    1    2    3    4    5    6    7    8    9
   not                              very
at all difficult                 difficult
```

2. How would you rank the clarity of your task?

```
   1    2    3    4    5    6    7    8    9
  not                               very
at all clear                       clear
```

3. How closely does the task resemble what you do on a day-to-day basis in the fleet?

```
   1    2    3    4    5    6    7    8    9
  does not                        resembles
resemble at all                very closely
```

4. Have you performed a similar task in the past?   Y   N
   a. If "YES" how long ago? (in years/months)_____

5. To what extent were the concepts of decision support information clear to you (as explained by the instructions and the experimenter)?

```
    1    2    3    4    5    6    7    8    9
Not clear                              Very
at all                                clear
```

6. To what extent was decision support information helpful in improving your own decision?

```
    1    2    3    4    5    6    7    8    9
Not at all                             Very
helpful                             helpful
```

7. To what extent was information about the ship's actual position helpful in improving your own decision?
```
    1    2    3    4    5    6    7    8    9
Not at all                             Very
helpful                             helpful
```

8. Now that you have completed the task, can you think of any other factor (other variables, etc) that may have influenced you in making your decision?

_____
_____
_____
_____

9. How clear were the instructions regarding the task?
    1   2   3   4   5   6   7   8   9
Not clear   Very
at all   clear

10.   How   would   you   present   the   task
differently?_____

_____
_____
_____

11. How seriously did you take this task, generally?

    1   2   3   4   5   6   7   8   9

   not   very
seriously   seriously

12. How easy was this system to use?

    1   2   3   4   5   6   7   8   9
Not at all   Very
easy   easy

TASK DEBRIEF SURVEY

Outcome Feedback

1. How would you rank the difficulty of your task during the
past 40 scenario snapshots?

```
    1    2    3    4    5    6    7    8    9
   not                                   very
at all difficult                      difficult
```

2. How would you rank the clarity of your task?

```
   1    2    3    4    5    6    7    8    9
  not                                   very
at all clear                          clear
```

3. How closely does the task resemble what you do on a
day-to-day basis in the fleet?

```
   1    2    3    4    5    6    7    8    9
 does not                           resembles
 resemble at all                  very closely
```

4. Have you performed a similar task in the past?   Y   N
    a. If "YES" how long ago? (in years/months)_____

5. Now that you have completed the task, can you think of any
other factor (other variables, etc) that may have
influenced you in making your decision?

_____
_____
_____

6. How clear were the instructions regarding the task?

```
    1    2    3    4    5    6    7    8    9
Not clear                              Very
at all                                clear
```

7.   How   would   you   present   the   task
differently?_____
_____
_____

8. How seriously did you take this task, generally?

```
     0    1    2    3    4    5    6    7    8    9    10
   not                                            very
seriously                                      seriously
```

9. To what extent was information about the ship's actual
position helpful in improving your own decision?

```
     1    2    3    4    5    6    7    8    9
Not at all                                  Very
helpful                                     helpful
```

10. How easy was this system to use?

```
     1      2      3      4      5      6      7      8      9
Not at all                                         Very
easy                                               easy
```

MAP OF CARIBBEAN
(National Geographic, 1988)

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